PROJECT facts

U.S. DEPARTMENT OF ENERGY
NATIONAL ENERGY TECHNOLOGY LABORATORY

ENVIRONMENTAL WATER AND RESOURCES

06/2000

TREATMENT OF METAL-LADEN HAZARDOUS WASTES WITH CLEAN COAL TECHNOLOGY BY-PRODUCTS

PRIMARY PROJECT PARTNER

University of Pittsburgh
Pittsburgh, PA

MAIN SITE

University of Pittsburgh
Pittsburgh, PA
Yukon Plant
Mill Service, Inc.
Yukon, PA
Dravo Research Laboratory
Pittsburgh, PA

TOTAL ESTIMATED COST

$889,691

COST SHARING

DOE	$719,052
Non-DOE	$170,639

Description

Metal-contaminated wastewater, sludge, and soil are generated by a variety of industrial processes. The metals in these materials can be leached and transported into streams or groundwater if the wastes are not properly managed, threatening human health and the environment.

Typically, metal-contaminated wastes are chemically stabilized using lime and solidified with Portland cement to prevent any future contaminant transport. The cost of these treatment chemicals adds substantially to the overall cost of managing metal-contaminated wastes. In addition, large volumes of materials may be required, adding to development pressure on resources.

Advanced coal power processes such as circulating fluid-bed combustors (CFBCs), pressurized fluid-bed combustors (PFBCs), and spray dryers, developed under the DOE's Clean Coal Technology program, use an alkaline sorbent—limestone, dolomite or lime—to remove the SO_2 generated by burning coal. The overall by-product from these processes is a dry alkaline mixture of calcium sulfite/sulfate, ash, and unreacted calcium or magnesium oxides. These by-products have many of the characteristics of expensive treatment chemicals, which are used for commercial hazardous waste stabilization and solidification.

Many regional hazardous waste treatment companies are located close to coal-fired electric power plants where alkaline by-products are now, or may soon be, available. Demonstrating the use of Clean Coal Technology by-products in a commercial hazardous waste treatment plant will help open the market for these new materials in the hazardous waste treatment industry.

A two-phased testing program is being conducted. The first phase, using standard bench-scale treatability studies, has shown that spray dryer by-products are an excellent stabilization chemical for metal-laden solid hazardous wastes, such as contaminated soils and industrial sludges (Figure 1). The CFBC and PFBC by-products provide less stabilization than the spray dryer material but better solidification. The results of this first phase of work are being distributed through conferences and journal articles.

The second phase of work will test the performance of these new treatment chemicals on metal-laden solids in a commercial hazardous waste treatment plant.

NETL

Treatment of Metal-Laden Hazardous Wastes with Clean Coal Technology By-Products

The by-products studied in this program are all generated by lime-based dry SO_2 control processes. The residual lime content of the by-products makes them both alkaline and pozzolanic, or self-cementing. When they are added to metal-laden solid hazardous waste, their alkalinity increases the pH of the mixture, changing the chemical form of the metals in the waste and making them less soluble. The by-product's pozzolanic nature leads the lime-ash mixture to hydrate and recrystallize when wetted, encapsulating the metal-containing particles. When cured and hardened, the by-products become barriers to moisture and prevent the metals from leaching into the environment. After verifying stabilization, the treater can dispose of the treatment product in an industrial landfill. However, with proper permitting, the product may be usable in a structural fill.

In commercial operation, the by-products must be collected and transported pneumatically as a dry solid to maintain their chemical reactivity. By-product transfer and mixing must be accomplished without significant fugitive dust emissions. Bag filters and an enclosed mixer such as a pug mill generally provide adequate dust control.

Goal

To ensure the most cost-efficient delivery of electrical power, the U.S. Department of Energy (DOE) is conducting research and development to improve coal combustion by-product (CCB) management. The research program emphasizes characterization and reuse of CCBs to help stimulate markets for new materials such as those produced under the DOE's Clean Coal Technology program. Over the next 5 to 10 years, the program's goals are to develop processes leading to a 100% increase in the current rate of FGD by-product use, a 10% increase in the national rate of overall CCB use, and a 25% increase in the number of CCB applications considered "allowable" under state regulations.

Benefits

- New uses for clean coal technology by-products are commercialized, providing a potential revenue source for generators.
- Inexpensive treatment chemicals are made available to commercial hazardous waste treatment facilities.
- Detailed studies will provide insights into the mechanisms of metal stabilization.
- Commercial demonstration will provide regulators and operators with tools for decision making

CONTACT POINTS

James T. Cobb, Jr.
University of Pittsburgh
Pittsburgh, PA
(412) 624-7443
(412) 624-9639 fax
cobb@engrng.pitt.edu

Scott Renninger
U.S. Department of Energy
National Energy Technology Laboratory
Morgantown, WV
(304) 285-4790
(304) 285-4403 fax
scott.renninger@netl.doe.gov

PROJECT PARTNERS

Mill Service, Inc.
Pittsburgh, PA
(waste sample identification and analysis; treatability studies)

Dravo Lime Company
Pittsburgh, PA
(collection and analysis of by-product samples)

CONSOL Inc.
Pittsburgh, PA
(contribution of spray dryer by-product)

Ebensburg Power Company
Ebensburg, PA
(contribution of CFBC by-product)

Ohio Power Company
Brilliant, OH
(contribution of PFBC by-product)